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THE SUSCEPTIBILITY TO PLAGUE OF THE WEASEL, THE CHIPMUNK, AND THE POCKET GOPHER.*

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The rodents forming the subject of this paper are difficult to secure alive, and consequently the evidence presented here of their susceptibility to plague infection is not as extensive as might be desired.

The weasel (*Putorius xanthogenys*).—But two of these rodents have lived long enough in captivity to make it feasible to use them for experimental purposes. This animal is of special interest in regard to its susceptibility to plague as it is a predatory rodent and is believed to be a natural enemy of rats and ground squirrels which as is well known are frequently found infected with plague in nature. Indeed, weasels and allied species are sometimes used as rat exterminators.

In the first experiment a weasel weighing 110 gms. was inoculated by the cutaneous method (vaccinated) with a 48-hour agar culture of *B. pestis* that had been isolated about 15 months before from the spleen of a naturally infected plague rat that had been trapped in San Francisco. The eleventh generation on agar was used. The weasel died about 48 hours after the inoculation. The only lesion was a slight reaction at the site of inoculation and an enormously enlarged spleen which was very dark in color. A pure culture of *B. pestis* was isolated from the liver of the animal. The control used was a guinea-pig weighing 350 gms. This animal died on the ninth day, and at autopsy presented the lesions of subacute plague. The ninth day is rather late for a guinea-pig to die of plague, and, in consequence, we may assume that the culture that proved fatal to the weasel in two days was not an especially virulent one.

In the second experiment the culture used was one isolated in San Francisco from a naturally infected plague rat, but subse-

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quently the culture had been passed through a long series of ground squirrels without subculture on artificial media. This passage through the ground squirrels seemed to have no appreciable influence upon the virulence of the culture. A 48-hour-old broth culture was injected subcutaneously, the dose being shown in the following table, which also shows the fate of the various animals inoculated.

TABLE 1.

Animal	Weight gms.	Dose of Culture	Days before Death	Lesions	Cultures
Weasel.....	265	2 c.c. Subcutaneously	3	Acute plague	B. pestis from spleen
Guinea-pig .	320	0.5 c.c. "	4	" "	None made
Guinea-pig .	380	Vaccinated	5	" "	" "
Guinea-pig .	305	Infected needle thrust under the skin	4	" "	Contaminated
White rat ..	85	0.5 c.c. subcutaneously	5	" "	B. pestis from liver
White rat ..	160	Infected needle thrust under the skin	Killed on 47th day	None	None made

The control guinea-pigs died in the usual time. One of the white rats used for control purposes succumbed to acute plague; the other was found to be healthy when killed. The dose of culture given to the weasel was so large that no very safe conclusion is to be drawn from the experiment.

A guinea-pig which was vaccinated with the spleen of the dead weasel died on the fourth day, showing that the bacillus had undergone no change in virulence by passage through the weasel.

The chipmunk (*Callospermophilus* [*Citellus*] *chrysodeirus*).[1]— This little rodent is usually called the Gilded Ground Squirrel. It is fairly closely related to *Citellus beecheyi* (California Ground Squirrel) which has been found naturally infected.

The specimen forming the subject of the first experiment was caught in a rat trap in San Francisco and was probably a pet that had escaped. The chipmunk was vaccinated with the bubo of a guinea-pig that had died on the sixth day after inoculation from a naturally infected ground squirrel. The chipmunk died on the fourth day and at autopsy presented the usual lesions of acute plague in squirrels. Smears from the bubo and from the spleen showed an enormous number of pest-like bacilli. No cultures were made. Three wild rats (*Mus norvegicus*) were used as controls. Two of these died on the fourth day; the third, on the seventh day. All presented at autopsy the usual lesions of plague in rats. The controls demonstrated that the culture was quite virulent. The spleen of the dead chipmunk was used to vaccinate a guinea-pig, which died of plague on the sixth day, showing that the bacillus was virulent after passing through the chipmunk.

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[1] I am indebted to Professor Joseph Grinnell, of the Department of Mammalogy of the University of California, for the identification of this rodent.

For the second experiment, we had three chipmunks that had been trapped in the vicinity of Lake Tahoe, California, a natural habitat of this rodent. In this experiment, the infecting agent was contained in the bubo of a guinea-pig, dead on the seventh day after inoculation, from a naturally infected ground squirrel. All of the animals shown in the following table were vaccinated with the same material.

TABLE 2.

Animal	Weight gms.	Days before Death	Lesions	Cultures
Chipmunk................	230	3	Acute plague	B. pestis from liver
Chipmunk (*b*).............	?	3	" "	" " " "
Chipmunk................	?	3	" "	" " " "
Guinea-pig (control).......	315	12	Chronic plague	None
Guinea-pig (control)........	...	18	" "	"

It is a remarkable fact that the three chipmunks died on the same day (third). All presented the lesions of acute plague. That the control guinea-pigs died so long after inoculation (12 and 18 days) indicates that the bacilli contained in the bubo were but slightly virulent for guinea-pigs or that they were very few in number. That the guinea-pig dying on the eighteenth day harbored virulent plague bacilli is shown by the fact that pus from a bubo of this guinea-pig when used to inoculate another guinea-pig caused the death of the latter of acute plague in five days. A guinea-pig was vaccinated from the liver of one of the chipmunks (*b*). This guinea-pig died of acute plague on the fourth day.

California pocket gopher (*Thomomys bottae*).—In a previous paper[1] several experiments on the susceptibility of gophers to plague were reported. These experiments seemed to show that the gopher was relatively immune to infection with *B. pestis*. Since that report was made two additional experiments have been made, both of which tend to confirm the conclusion previously reached. In the first of the experiments reported here, a three-day broth culture of *B. pestis*, which had been isolated about two months before from the spleen of a naturally infected ground squirrel, was used as the infecting agent. The second generation on artificial media was used. As will be seen in the accompanying table an attempt was made to vary the dose as it was thought that possibly the immunity of gophers was such that it might be overcome by the use of a very large dose of culture. The results indicate that this is probably true. It is needless to state that all of the doses given were much larger than an animal would ever get under natural conditions. On account of the scarcity of gophers a more extensive variation in dose was impracticable.

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[1] *Jour. Infect. Dis.*, 1909, 6, p. 283.

TABLE 3.

Animal	Weight gms.	Dose of Culture	Days before Death	Lesions
Guinea-pig (control ...	780	0.1 c.c. subcutaneously	12	Subacute plague
Guinea-pig (control)...	563	0.1 c.c. "	7	" "
White rat (control)....	180	0.1 c.c. "	4	Acute plague
Gopher.............	200	0.1 c.c. intraperitoneally	Killed on 10th day, negative	None
Gopher.............	150	0.1 c.c. subcutaneously	Killed 10th day	Abscess at site (see below)
Gopher..............	135	0.1 c.c. "	5	Acute plague
Gopher..............	300	2.5 c.c. "	5	" "

The large doses were sufficient to kill the gophers on the fifth day. The smaller dose (identical with that given to the controls) had no influence on one of the gophers, and in the other merely gave rise to a local necrosis. A considerable quanity of the pus from the abscess in the latter case was injected beneath the skin of a guinea-pig and caused its death of acute plague on the sixth day. The two gophers that had not succumbed by the tenth day were chloroformed at that time, the object of killing the animals at such an early date being the detection of slight lesions that might have disappeared had the animals been kept longer. It is rather remarkable that the only gopher to escape unscathed in this experiment was the one in which the culture had been inoculated intraperitoneally. It should perhaps be stated here that, as the guinea-pigs died late, the culture was probably not a very virulent one.

In the second and last experiment a uniform dose of culture was administered to all of the animals in the series. The culture was one that had been obtained by aspirating the primary bubo of a child about 36 hours after the onset of the symptoms of plague. At the time of the present experiment, the culture had been carried upon artificial media for about seven months. The third generation was used. The results of the experiment are shown in the following table.

TABLE 4.

Animal	Weight gms.	Dose	Days before Death	Lesions
Guinea-pig	320	0.1 c.c. 48-hr. broth culture	5	Acute plague
Guinea-pig	360	" " " "	6	" "
White rat	100	" " " "	2	Early plague
Gopher	180	" " " "	3	Acute plague (B. pestis isolated from heart's blood and from liver)
Gopher	225	" " " "	Alive and well on 50th day	
Gopher	225	" " " "	" " " " " "	
Gopher	230	" " " "	" " " " " "	

The results in the case of the control animals indicate that the culture was fully virulent; nevertheless, but one of the gophers succumbed.

SUMMARY.

These experiments indicate that the weasel (*Putorius xanthogenys*) and the chipmunk (*Callospermophilus* [*Citellus*] *chrysodeirus*) are quite susceptible to plague infection.

As compared with control animals, the susceptibility of the gopher (*Thomomys bottae*) is rather slight. This agrees with the results of previous experiments.